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*Indian Standard*

# GUIDELINES FOR USE OF VEHICLES FOR COLLECTION OF MUNICIPAL SOLID WASTES

## PART 1 SELECTION OF VEHICLES

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NEW DELHI 110002

*October* **1989** **Price Group 2**

Solid Wastes Sectional Committee, CDC 54

## FOREWORD

This Indian Standard (Part I) was adopted by the Bureau of Indian Standards on 28 February 1989 after the draft finalized by the Solid Wastes Sectional Committee had been approved by the Chemical Division Council.

The solid waste produced from habited areas is normally collected and transported away by a variety of vehicles to the processing or disposal sites. The vehicles involve a large amount of capital investment as well as running expenditure and hence need to be selected with proper care.

Different types of vehicles are suitable for different situations and it is necessary to keep this in mind and select appropriate vehicles to obtain maximum efficiency least cost. These guidelines are, therefore, being prepared with a view to given an idea about the various types of vehicles, their advantages and disadvantages and suitability under different conditions. It is felt that by using these guidelines, the users can select appropriate vehicles.

# *Indian Standard*

# GUIDELINES FOR USE OF VEHICLES FOR COLLECTION OF MUNICIPAL SOLID WASTES

## PART 1 SELECTION OF VEHICLES

### 1 SCOPE

This standard ( Part 1 ) prescribes the guidelines for selection of vehicles for collection and transportation of urban solid wastes to processing or disposal site.

### 2 REQUISITES OF REFUSE VEHICLES

The requisites of refuse vehicles used in collection and transportation of urban solid wastes are as follows:

a) The city refuse has a low density (as compared to building materials) and hence for optimum utilization of the engine capacity of the vehicles, the body capacity should be large.

b) Refuse is normally corrosive in nature and hence the vehicle body should be such that the chances of material accumulating leading to corrosion are minimal.

c) The vehicle body should be such that the material is not exposed to the atmosphere. this can be done either by using a closed body vehicle or by using a simple method of covering the collected waste.

d) Majority of the vehicles work on fossil fuel and hence (to reduce the cost ) it is desirable that they should be diesel driven.

e) Method of unloading the contents should be such that it can be quickly carried out. In the case of hydraulic tipping arrangement, it is desirable to use 2 stage telescopic cylinder type tipping device with a minimum tipping angle of 45°. The hydraulically operated tipping arrangement should be powered by the prime mover of the same vehicle.

f) Where the transportation distance is going to be very large, smaller vehicles can be used for collection from individual areas. These vehicles can then discharge their contents in larger vehicles at a transfer station.

g) As far as possible, the number of types of vehicles should be least so that inventory for spare parts for maintenance is kept to a minimum.

h) If loading in the vehicles is manually carried out, the loading height should be less than 1·2 m.

j) Vehicle should be of rugged construction and should have at least two coats of anti-corrosive paint. It is advantageous if a specific colour is used with help in identifying the refuse vehicles.

k) As the roads in Indian towns and cities are quite narrow, the turning radius of the vehicle should be as small as possible.

m) As the vehicles have to move in rough terrain, the vehicle should be in good condition. Sometimes, it is observed that new vehicles are used for some other purpose and are assigned for refuse transportation after they become old. Such old vehicles breakdown often due to difficult conditions under which they have to work and hence such practice should be avoided.

n) The vehicle should conform to the various provisions of relevant Motor Vehicle Act.

p) The vehicle should be such that its maintenance is easy and does not require highly skilled personnel.

q) The unladen weight of the vehicle and its equipment should be minimum to enable maximum utilization of the pay load capacity.

Some of the common types of vehicles used for transportation of refuse are described and discussed in 3.

### 3 COLLECTION AND TRANSPORTATION VEHICLES

#### 3.1 Animal Driven Cart

These vehicles are sometimes used for removal of refuse from narrow lanes and byelanes and have a small capacity of 1 to 1·5 m³. These vehicles are slow in movement and may pose problems when used on main road. Hence, their use should be restricted to subsidiary roads and for such periods when traffic is not heavy. The wheels are often provided with iron tyres which reduce the maintenance cost but tend to damage the pavement. Whenever adequate maintenance facilities are available, pneumatic type wheells should be preferred. The wheels should be mounted on roller bearings supporting the axle for better transportation. The container at the back should be properly designed to contain the refuse without spillage. Provision should be made for covering the material by tarpaulin. The loading and unloading is quite simple and does not pose any problem. This type of vehicle saves on fuel cost but due to its lesser speed can operate only on short distances.

### 3.2 Padal Tricycle

As an alternative to the animal drawn vehicle, tricycles can be used. These can have a container of 0·2 to 0·25 $m^3$ capacity mounted on the back side of the driver's seat. This vehicles will have the advantage of being able to move through lanes and can move at a speed higher than animal driven vehicle. The container should have loading flaps at the top hinged at the middle. The unloading should be done at the rear end by tilting the container over an axis located above the rear axle. A simple working arrangement should keep the container locked horizontally under normal operating conditions.

A fractional horsepower petrol engine is sometimes used for such vehicles but is found to be unsuitable requiring larger maintenance and higher fuel cost. This is an unreliable arrangement at higher speeds.

### 3.3 Short Range Small Capacity Vehicle

A few designs have recently been introduced having a small diesel engine (3·728 5 to 5·592 8 kW) to carry 1 to 1·5 tonnes of material. These have a low loading height ( 1·5 m ), short turning radius ( 2·8 - 4·5 m ) and offer fuel economy ( 8 - 12 km/litre ). In one type of these vehicles, a simple tipping arrangement is provided in which the container held in position by a chain can be tilted by releasing the chain. In another type in addition to covered body, covered space to seat a driver and 2 labourers is also provided. These vehicles have a simple, robust construction and are economical to operate. These vehicles may be useful as satellite vehicles fitted into larger vehicles.

### 3.4 Tractor Trailor System

This combination is commonly used in the case of smaller towns where the distance through which the waste has to be transported is less and where the roads are not completely paved. However, if they are used in bigger cities, they pose problems due to their slower speed. For optimum use, it is desirable to have a single tractor serving a number of trailors parked at different locations as bins. This helps in reducing the number of handling steps and enables a tractor to make more number of trips. Permanently fixed tractor trailor does not give this flexibility and can make lesser number of trips and will prove uneconomical. However, when the trailors are being used as refuse bins, they should be protected from theft of tyres and other mischieves.

### 3.5 Container Carrier System

This system comprises of a number of standardized containers which are towed by a tractor with the help of a hydraulic carrier. During operation, the tractor along with the hydraulic carrier carries an empty container which is deposited at the binsite and the full container is taken away to the processing or disposal site. In this way, it is claimed that a single tractor and carrier combination can take care of a number of containers.

The system has the advantage of having a low loading height and reduction in number of handling steps. The number of containers that can be handled in a day depends upon the distance to the disposal site. However, this system has a slow speed of movement and poses problems in manoeuvring due to longer length requiring wider roads and also larger space at container site. Further, it has been observed that the ground clearance of the hoisted container is low which poses problems on the uneven roads at the disposal sites. As the system has a number of moving parts, even if one of the parts is out of order, the whole system remains idle.

### 3.6 Conventional Trucks-System

In a large majority of towns, it is observed that conventional trucks are used for refuse transportation. As refuse is a low density material, for proper utilization of engine capacity a larger body size should be used. Alternatively, recently introduced mini trucks with raised sides can result in better utilization of engine capacity.

It is also observed that the conventional trucks have a higher loading height posing problems in the loading of the vehicle.

One of the major problems encountered in such cases is that these are multipurpose vehicles and it is commonly observed that when new, they are used for transportation of other materials and put for refuse transportation when they become old. It is hence desirable that while purchasing such vehicles, the body size should be increased consistent with the density of the material.

Such vehicles normally are not provided with covered body which poses problems due to spilling of the material, aesthetics of appearance, etc, problems. Hence, simple arrangement for covering the material by the use of the tarpaulin, etc, should be considered.

### 3.7 Special Municipal Vehicles

In this system, large size containers of 6 to 10 $km^3$

capacity are normally used as refuse bins and when full, they are lifted and put on the chassis by the use of a special winch mechanism provided on the truck chassis. Thus this system enables transportation of larger quantity of material through bigger bins which are taken away by a normal truck prime-mover. This gives a higher speed and higher ground clearance during movement. However, it requires largers pace where bins are provided as normally the prime-mover comes with an empty container, unloads it at the site and transports away the filled container. Further, due to the large capacity of the bins, this system can be used only at such points where large amount of waste is expected to accumulate.

The containers have movable flats and unloading of the wheel-barrow after lifting the flaps poses problem with the result that it is common that the refuse workers dump the refuse from wheelbarrow on the ground and then deposit it into the container. This increases the number of handling steps and results in environmental pollution. It is also observed that to keep the surrounding clean, a worker has normally to be posted at such points thus increasing the cost.

**3.8 Compactor Vehicles**

These vehicles are commonly used where low density material (containing paper, plastics etc) is compacted from an initial density of 125 to 150 kg/m$^3$ to about 500 kg/m$^3$. As the Indian municipal refuse (containing large proportion of fines and inorganics) already has a higher density of about 500 kg/m$^3$, the increase in density after compaction (compaction ratio) is not high. Further, as the capital cost is comparatively higher, it proves uneconomical for operation.

It is also observed that due to poor maintenance, the body is not regularly cleaned leading to its corrosion. Unless the workers are properly trained in the use of various mechanical gadgets, optimum utilization of the vehicle will not occur.

Thus these vehicles can be used only in such cases when the refuse has a low density, is amendable for compaction and the maintenance facilities are good.

**3.9 Refuse Collector**

These vehicles have recently been introduced and are normally having a covered body with a low loading height. In one type, a mechanism is provided which ensures that the waste put in the hopper is pushed inside so that the body can be completely filled. This mechanism may also give some incidental compaction. Due to low loading height, the productivity of workers is also expected to increase.

The closed body should be regularly clearned to avoid corrosion due to organic matter retained in corners, etc. The workers should also be properly trained to ensure proper use of collector plate. The vehicle due to its size may not be able to turn and move in small lanes and by lanes. These have been recently introduced and the actual productivity and operational experience (maintenance problems and replacement of parts, etc) over a reasonable period will help in its evaluation.

## 4 SELECTION OF VEHICLES

A wide variety of vehicles are available in the country each suitable for specific situation. Hence, selection of a vehicle should be made after carefully evaluating all possible alternatives. For evaluating the comparative cost, it is desirable to find out cost/tonne/km.

This can be calculated in the following manner.

a) Annualized cost over 7 years.

b) Waste transported/year
   =Weight per trip × no. of trips/day × average no. of working days/year.

c) Manpower cost = No. of persons/vehicle × annual salaries of these persons

d) Fuel cost/year = litres consumed/year × cost/litre.

e) Maintenance cost @ 10 percent per year of capital cost.

f) Supervisory cost @ 10 percent of labour cost.

g) Cost/tonne/km = $\frac{a+c+d+e+f}{b}$

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